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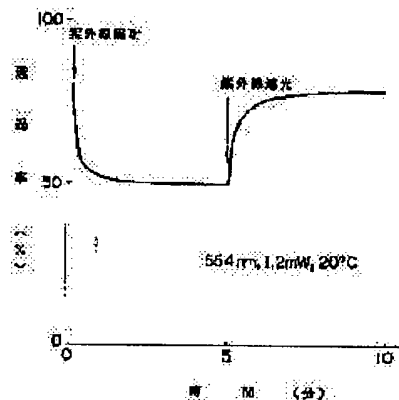
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(54) MANUFACTURE OF PHOTO CHROMIC PLASTIC LENS

(57)Abstract:

PURPOSE: To have a sufficient photo chromic property, to satisfy the characteristics as the lens (the first object), and to offer the lens of higher surface hardness and superior to wear resistance (the second object).

CONSTITUTION: The first object is attained by polymerizing a monomer mixture consisting essentially of (a)-(d) components under the polymerization condition not including a peroxide polymerization initiator. (a) a methylacryl monomer selected from monofunctional methacrylic acid ester and polyfunctional methacrylic acid ester (b) a hydrophilic monomer selected from (meth)acrylic acid and a hydroxy group containing (meth)acrylic acid ester, (c) α -polyfunctional cross-linking monomer, (d): an effective quantity of photo chromic dye. The second object is attained by further including the process that it is conducted a plasma treatment for the plastic lens, being applied a coating compound consisting essentially of (e) and (f) components, being hardened and formed a hardened film. (e): an organic silicon compound having a silanol group and an epoxy group, and (f): colloidal silica.



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(a) TMPTMA high hard mono, spec, p.18

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention relates to the manufacture approach of a photochromic plastic lens.

[0002]

[Description of the Prior Art] The exposure of the light of short wavelength colors, the lens using the photochromic nature which will be decolorized if it is left in an exposure and heating of the light of long wavelength, or a dark place is known, and the photochromic glass containing a silver halide is used as a sunglasses ingredient.

[0003] Although it could, on the other hand, consider making the diethylene-glycol bisallyl carbonate resin base material well known as for example, a spectacle lens ingredient contain the photochromic matter in order to obtain the plastic lens which has photochromic nature, there was a trouble that photochromic nature could not obtain a photochromic lens dissipation or since it declines remarkably, for the peroxide system polymerization initiator used for a large quantity in this case at the time of lens shaping.

[0004] so, to JP,61-228402,A A photochromic color content resin solution is applied and heated to this diethylene-glycol bisallyl carbonate resin base material. Since the photochromic color in the resin film is permeated or diffused in said base material, the photochromic color lack resin film is removed. Then, the method of giving the hardening film is indicated, and the approach of making coating liquid add a photochromic color, applying this to a lens, and forming the photochromic color content hardening film in JP,62-10604,A is indicated.

[0005] By the way, a plaque tic lens has the problem that surface hardness is inferior, on physical properties, and carrying out spreading hardening of the polyorganosiloxane system coating constituent which becomes acrylic resin from the hydrolyzate, the epoxy resin compound, and the epoxy curing agent of an organic silicon compound is indicated by JP,61-166824,A as the amelioration.

[0006]

[Problem(s) to be Solved by the Invention] However, the approach indicated by above-mentioned JP,61-228402,A needed the processing in the elevated temperature

exceeding the heat-resistant temperature of a base material, in order to obtain sufficient photochromic concentration, consequently the dry area arose on the lens front face, and problems, like a lens side is distorted were shown in it.

[0007] Moreover, that a limitation is in the solubility to the inside of the coating liquid of a photochromic color, and sufficient photochromic nature is hard to be obtained, even if the amount of dissolutions of the approach indicated by above-mentioned JP,62-10604,A of a photochromic color increased, it had the trouble that the physical properties of the photochromic color content hardening film will fall.

[0008] Furthermore, the polyorganosiloxane system hardening film indicated by above-mentioned JP,61-166824,A did not have the enough abrasion resistance to physical washing or contact, and had a trouble of imperfection in surface hardness. Moreover, when the metal colloid which is an abrasion resistance improver general to this polyorganosiloxane system hardening film was added, there was a trouble that adhesion with base material resin (especially acrylic resin) fell remarkably.

[0009] This invention is for canceling the fault of the manufacture approach of the above-mentioned conventional photochromic plastic lens. It is in the 1st object offering the manufacture approach of a photochromic plastic lens of having sufficient photochromic nature and also satisfying the property as a lens. The 2nd object has sufficient photochromic nature, and also satisfies the property as a lens, and is to offer the manufacture approach of a photochromic plastic lens that moreover surface hardness was highly excellent in abrasion resistance.

[0010]

[Means for Solving the Problem] The 1st object of the above was attained by the manufacture approach of the photochromic plastic lens characterized by including the process which obtains the plastic lens which has photochromic nature by carrying out the polymerization of the monomer mixture which uses (a), (b), (following c), and the following (d) component as a principal component under the polymerization conditions which do not contain a peroxide system polymerization initiator. (a) At least one sort of hydrophilic monomers, the photochromic color of at least one sort of polyfunctional cross-linking monomers, and (c) (d) effective dose which are chosen from at least one sort of methacrylic system monomers and the (b) (meta) acrylic acid which are chosen from monofunctional methacrylic ester and polyfunctional methacrylic ester, and hydroxyl-group content (meta) acrylic ester.

Moreover, the 2nd object of the above was attained by including further the process which applies and hardens the coating constituent which carries out plasma treatment of the plaque tic lens obtained in the top, and subsequently uses (following e) and the following (f) component as a principal component, and forms the hardening film. (e) The organic silicon compound, (f) colloid silica which have a silanol group and an epoxy group.

[0011] Hereafter, this invention is explained in full detail. In this invention, a photochromic plastic lens is obtained by carrying out the polymerization of the monomer mixture which uses (a), (b), (above-mentioned c), and the above-mentioned (d) component as a principal component under the polymerization conditions which do not contain a peroxide system polymerization initiator.

[0012] if this is contained like the after-mentioned in having been carried out on condition that a peroxide system polymerization initiator was not included here -- the photochromic color of the (d) component -- decomposing -- photochromic nature -- dissipation -- or it is because it declines remarkably.

[0013] The reason using the methacrylic system monomer of the (a) component as a monomer is for realizing an outstanding optical property called the high transparency and the lightfastness which acrylic resin has in the plastic lens obtained. In addition, as a methacrylic system monomer of this (a) component, at least one sort chosen from monofunctional methacrylic ester and polyfunctional methacrylic ester is used. As monofunctional methacrylic ester, a methyl methacrylate, ethyl methacrylate, N-butyl methacrylate, METAKURU acid ethylhexyl, methacrylic-acid benzyl, Methacrylic-acid phenyl, cyclohexyl methacrylate, methacrylic-acid isobornyl, methacrylic-acid adamantyl, etc. are mentioned. As polyfunctional methacrylic ester Ethylene glycol dimethacrylate, diethylene-glycol dimethacrylate, Triethylene glycol dimethacrylate, 1,4-butanediol dimethacrylate, 1, 6-hexanedioldimethacrylate, trimethylolpropanetrimethacrylate, pentaerythritol trimethacrylate, glycerol dimethacrylate, etc. are mentioned. (a) The content with a desirable component is 30 - 95 % of the weight in [all] monomer mixture, and is 40 - 95 % of the weight still more preferably. (a) a component -- a rate -- all -- a monomer -- mixture -- inside -- 30 -- % of the weight -- less than -- it is -- ** -- acrylic -- resin -- the description -- it is -- transparency -- lightfastness -- reinforcement -- etc. -- falling -- on the other hand -- 95 -- % of the weight -- exceeding -- if -- a hydrophilic group -- having -- a monomer -- it is -- (-- b --) -- a component -- a content -- relative -- decreasing -- a sake -- adhesion with the hardening film -- weak -- becoming .

[0014] (b) As a hydrophilic monomer as a component, at least one sort chosen from an acrylic acid (meta) and hydroxyl-group content (meta) acrylic ester is used. In addition, in this description, "an acrylic acid (meta)" means both "acrylic acid" and "methacrylic acid." As these examples, the chloro hydroxypropyl ester of the hydroxyethyl ester of an acrylic acid, a methacrylic acid, an acrylic acid, or a methacrylic acid, an acrylic acid, or a methacrylic acid etc. is raised. (b) The content with a desirable component is 5 - 50 % of the weight in [all] monomer mixture, and is 5 - 30 % of the weight still more preferably.

(b) If an improvement of adhesion with the hardening film becomes it weak that the rate of a component is less than 5 % of the weight in [all] monomer mixture and it, on the other hand, exceeds 50 % of the weight, absorptivity will become large, the physical properties on the front face of resin will become instability, and it will become easy to produce a dry area, a pit crater, etc. Moreover, the mold-release characteristic and imprint nature at the time of an allocated type get worse.

[0015] (c) The polyfunctional cross-linking monomer as a component is a cross-linking monomer which has two or more functional groups. As the example, ethylene glycol dimethacrylate, diethylene-glycol dimethacrylate, Triethylene glycol dimethacrylate, 1,4-butanediol dimethacrylate, 1, 6-hexanedioldimethacrylate, trimethylolpropanetrimethacrylate, Polyfunctional methacrylic ester, such as pentaerythritol tetra-methacrylate and glycerol trimethacrylate Ethylene glycol diacrylate, triethylene glycol diacrylate, Polyfunctional acrylic ester, such as 1,6-hexanediol

diacrylate, trimethylolpropane triacrylate, and pentaerythritol tetraacrylate, a divinylbenzene, etc. are raised. (c) Although the content with a desirable component changes with the classes, it is 3 - 50% of the weight of the range in [all] monomer mixture in general, and if ethylene glycol dimethacrylate is taken for an example, 3 - 30 % of the weight is desirable. (c) Troubles, like if the rate of a component becomes inadequate [thermal resistance] for it to be less than 3 % of the weight and it, on the other hand, exceeds 50 % of the weight, shock resistance will fall, or become easy to produce a crack, a crack, etc. at the time of mold release, and an allocated type becomes difficult generate and are not desirable.

[0016] (d) The photochromic color as a component is meltable to an above-mentioned monomer (a), (b), and (c), and requires that after a polymerization should maintain photochromic nature. As such a color, colors, such as a SUPIRO pyran system and a SUPIRO oxazine system, are used. As a SUPIRO pyran system color, Indore of in DORINO spirobenzopyran, and the halogen of the benzene ring, Indore of each substitution product, such as methyl, ethyl, methylene, ethylene, and a hydroxyl group, and an in DORINOSUPIRO naphth pyran, and the halogen of a naphthalene ring, Each substitution product, such as methyl, ethyl, methylene, ethylene, and a hydroxyl group, the halogen of the Indore ring of an in DORINOSUPIRO kino pyran, Each substitution product, such as the halogen of the Indore ring of each substitution product, such as methyl, ethyl, methylene, ethylene, and a hydroxyl group, and an in DORINOSUPIRO pyrid pyran, methyl, ethyl, methylene, ethylene, and a hydroxyl group, etc. is raised. As a color of a SUPIRO oxazine system, moreover, Indore of in DORINOSUPIRO benzoxazine and the halogen of the benzene ring, Indore of each substitution product, such as methyl, ethyl, methylene, ethylene, and a hydroxyl group, and in DORINOSUPIRO naphth oxazine, and the halogen of a naphthalene ring, Each substitution product, such as methyl, ethyl, methylene, ethylene, and a hydroxyl group, the halogen of the Indore ring of in DORINOSUPIRO phenanthro oxazine, Each substitution product, such as methyl, ethyl, methylene, ethylene, and a hydroxyl group, the halogen of the Indore ring of in DORINOSUPIROKINORINO oxazine, Each substitution product, such as the halogen of the piperidine ring of each substitution product, such as methyl, ethyl, methylene, ethylene, and a hydroxyl group, and piperidino SUPIRO naphth oxazine and a naphthalene ring, methyl, ethyl, methylene, ethylene, and a hydroxyl group, etc. is raised. It is still more effective, if the color of a SUPIRO oxazine system is desirable especially in respect of lightfastness and uses an organic nickel system stabilizer together among these. As a commercial item of a SUPIRO oxazine system color, Photo.PNO made from ENI, Tsukuba Science laboratory Sunmax (color content acrylic monomer), etc. can be mentioned.

[0017] (d) Although the desirable content of the photochromic color as a component cannot be uniquely specified since it changes greatly also with classes of photochromic color as shown in the below-mentioned example, an amount effective in happening smoothly, i.e., the depth of shade at the time of coloring, has the high color developing and reducing of the photochromic lens made into the object, and it chooses an amount to which the light transmission at the time of decolorization becomes high.

[0018] In addition, it is also possible to add other monomers in which (a), (b), the (c) component, and copolymerization are possible in the range which does not spoil the effectiveness of this invention into monomer mixture. As these monomers, ethyl methacrylate, n-butyl methacrylate, Methacrylic-acid ethylhexyl, methacrylic-acid benzyl, meta-RURIRU acid phenyl, Methacrylic ester, such as cyclohexyl methacrylate, methacrylic-acid isobornyl, and methacrylic-acid ADAMANSHIRU A methyl acrylate, an ethyl acrylate, acrylic-acid n-butyl, acrylic-acid ethylhexyl, Acrylic-acid cyclohexyl, acrylic-acid benzyl, acrylic-acid phenyl, Acrylic ester, such as acrylic-acid isobornyl, styrene, methyl styrene, Nuclear substitution styrene, such as dimethyl styrene, KURORU styrene, dichloro styrene, bromine styrene, and p-KURORU methyl styrene, alpha methyl styrene, acrylonitrile, a methacrylonitrile, a maleic anhydride, N-permutation maleimide, etc. are raised.

[0019] It is desirable to use a casting polymerization method in the manufacture approach of the photochromic plastic lens of this invention, and a heat-curing polymerization is usually adopted. That is, it is the approach of adding the polymerization initiator of optimum dose to monomer mixture, and pouring in and carrying out a heating polymerization to a mold. As a polymerization initiator at this time, azo system initiators, such as 2,2'-azobis isobutyronitrile, 2, and 2'-azobis (2,4-dimethylvaleronitrile), can use it suitably. As mentioned above, in order that peroxide system initiators, such as benzoyl peroxide, lauroyl peroxide, and t-butylperoxy-2-ethylhexanoate, may decline or vanish the effectiveness of a photochromic color, the activity of a peroxide system initiator should be eliminated. As for an initiator, it is desirable to usually use it in 0.001 - 5% of the weight of the range of a monomer total amount. Moreover, although heating temperature changes greatly with initiators to be used, it is usually the range of 20-80 degrees C. In addition, since the polymerization by strong optical exposure may make photochromic nature decline, it is not desirable.

[0020] Moreover, in this invention, a thermostabilizer, an antioxidant, an ultraviolet ray absorbent, a release agent, an antistatic agent, other colors, etc. can also be added in monomer mixture if needed.

[0021] The photochromic plastic lens obtained by this invention remains in a plastic lens, without the photochromic color which is the (d) component in monomer mixture decomposing, since the polymerization of the monomer mixture is carried out to the bottom of the condition which does not contain a peroxide system polymerization initiator and it is obtained. Therefore, the exposure of ultraviolet rays colors, and it has the so-called photochromic nature decolorized by protection from light of ultraviolet rays, and is preferably used for sunglasses etc.

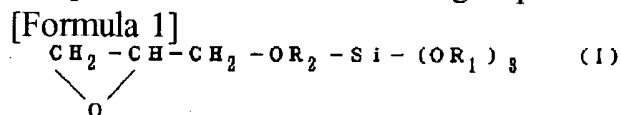
[0022] According to this invention, plasma treatment of the photochromic plastic lens obtained as mentioned above can be carried out, spreading of a coating constituent and hardening processing can also be performed further, the surface hardness of a plastic lens can improve by this, and the photochromic plaque tic lens excellent in abrasion resistance and abrasion-proof nature can be obtained.

[0023] Plasma treatment is usually performed by this invention within in 60 seconds under the ambient atmosphere of the non-polymerization nature gases 0.01, such as air, helium,

an argon, hydrogen, oxygen, and nitrogen, - 10Torr, although condition [the] also changes somewhat with the magnitude of the equipment to be used, a format, and configurations.

[0024] Spreading of the coating constituent to the plastic lens which finished plasma treatment, and hardening processing are performed as follows.

[0025] A coating constituent needs to include simultaneously the organic silicon compound which has a silanol group and an epoxy group, and a colloid silica. As an organic silicon compound which has a silanol group and an epoxy group, it is a general formula [0026].



[0027] The hydrolyzate of 3 organic-functions organic silicon compound expressed with (the inside R1 of a formula is the alkyl group of carbon numbers 1-4, and R2 is the alkylene group of carbon numbers 1-4) is desirable. As a 3 organic-functions organic silicon compound, it is R1 in a formula. It is a methyl group, an ethyl group, a propyl group, or butyl, and is R2. Especially the thing that is a methylene group, ethylene, a propylene radical, or a butylene radical is desirable.

[0028] On the other hand, in order to make it not leave as excessive water as possible after hydrolysis of an organic silicon compound as a colloid silica, a high-concentration moisture powder colloid silica (for example, SiO2 thing of 40% or more of solid content) is used preferably. The thing of particle diameter like 5 - 30mmicro is good. The coating constituent used especially by this invention demonstrates the usefulness, when a colloid silica is included by high concentration. It is desirable to set up the amount of the colloid silica in a coating constituent from the semantics more than 75 mol % (SiO2 solid content reduced property) on the basis of the whole quantity of a colloid silica and an organic silicon compound. Although especially a curing agent is not limited, the acetylacetone metal complex compound is effective, among those, but the aluminum complex compound of an acetylacetone can use it effectively especially. The addition is 1-10g to a total of one mol of the hydrolyzate of the amount which is sufficient for hardening a colloid silica and the hydrolyzate of an organic silicon compound, for example, a colloid silica, (SiO2 conversion), and an organic silicon compound.

[0029] (I) An organic acid is used for hydrolysis of the organic silicon compound of a formula. Although an acetic acid, a formic acid, a propionic acid, etc. are raised to this, it is desirable to use an acetic acid from the stability of a coating constituent. The addition of an organic acid is one mol of whole quantity of a colloid silica and an organic silicon compound. It receives and it is desirable that they are 5-30g. If fewer than this, it will become easy to produce gelation of a coating constituent, and if it increases more than this, an odor will become strong and workability will get worse.

[0030] Furthermore, in order to adjust the degree for hydrolysis moderately moreover to homogeneity, it is desirable to add a suitable solvent into a coating constituent. It is still more desirable, when cellosolves, such as methyl cellosolve, ethylcellosolve, and butyl cellosolve, are desirable and it combines with isopropyl alcohol, a butanol, etc. as such a

solvent. It is desirable especially desirable that it is 3% of the weight or more of the total amount of solvents, and the rate of cellosolve is 10 % of the weight or more. When there are many especially rates of a colloid silica, it becomes difficult for the rate of the cellosolve in a solvent to produce gelation during preparation of a coating constituent in less than 3% of the weight of the total amount of solvents, and to consider as a coating constituent.

[0031] To the coating constituent used by this invention, a silicone system surfactant can also be added in order to raise the smooth nature of a paint film. Furthermore, it is also possible to add an ultraviolet ray absorbent, an antioxidant, etc. for the object of the improvement in lightfastness or degradation prevention of a paint film. A coating constituent can be applied to a lens base material with a dipping method, a spin coat method, the roll coat method, a spray method, etc. Hardening of the applied coating constituent is performed by heat-treating, 40-150 degrees C is desirable especially desirable, and heating temperature is 80-130 degrees C. 1 - 4 hours of heating time are desirable.

[0032]

[Example] Hereafter, an example explains this invention in more detail. In addition, the approach of the physical-properties assessment in an example and the example of a comparison is as follows.

[0033] (a) It judged by the responsibility of permeability change of the lens at the time of the UV irradiation by the photochromic nature high-pressure mercury-vapor lamp and protection from light.

[0034] (b) Friction of the front face was carried out 50 times (round trip) by 1000g of addition loads by surface hardness steel wool #0000, and the difficulty of being attached of a blemish was judged on the following criteria.

A: A blemish hardly sticks.

B: A blemish sticks for whether being *****.

C: A blemish attaches a few.

D: Many blemishes stick.

[0035] (c) The adhesion hardening film front face was cut into the grid (10x10 pieces) of 1mm spacing, cellophane adhesive tape (No[by Nichiban Co., Ltd.]. 405) was stuck strongly, and the number of the grids which stripped in the direction of 90 degrees rapidly, and remained in it was investigated.

[0036] (d) Appearance macro-scopic viewing investigated transparency, the coloring condition, the surface state, etc.

[0037] Moreover, preparation of the coating constituent used in examples 2-20 and the example 1 of a comparison was performed as follows.

(i) SiO₂ Having made into 35 degrees C the liquid which added the 0.5-N hydrochloric-acid 2.0 weight section and the acetic-acid 20 weight section to the colloid silica (Snow tex -40, moisture powder silica, product made from Nissan Chemistry) 240 weight section of 40% of concentration, and stirring it, the gamma-glycidoxypropyltrimetoxysilane (3 organic-functions organic silicon compound) 95 weight section was dropped, and at the room temperature, it stirred for 8 hours and was

left after that for 16 hours. Added the methyl-cellosolve 80 weight section, the isopropyl alcohol 120 weight section, the butyl alcohol 40 weight section, the aluminum acetylacetone 14 weight section, the silicone system surfactant 0.2 weight section, and the ultraviolet ray absorbent 0.1 weight section to this hydrolysis solution 320 weight section, it was made to ripe at the room temperature after 8-hour stirring for 24 hours, and the coating constituent was obtained. Let this be a coating constituent (A). At this time, the amount of the colloid silica in a coating constituent was 80mol % (SiO₂ solid content reduced property) on the basis of the total quantity of a colloid silica and gamma-glycidoxypopyltrimetoxysilane.

[0038] (ii) The coating constituent (B) was obtained like preparation of a coating constituent (A) except having made the amount of gamma-glycidoxypopyltrimetoxysilane into 67 weight sections. The amount of the colloid silica in the coating constituent at this time was 85mol % (SiO₂ solid content reduced property) on the basis of the total quantity of a colloid silica and gamma-glycidoxypopyltrimetoxysilane.

[0039] (iii) The coating constituent (C) was obtained like preparation of a coating constituent (A) except having replaced with the colloid silica and having used the ion-exchange-water 120 weight section.

In the [example 1] methyl-methacrylate 70 weight section, the methacrylic-acid 2-hydroxyethyl 10 weight section, as the ethylene glycol dimethacrylate 20 weight section and a SUPIRO oxazine system photochromic color -- the product made from ENI -- Photo.PNO the 0.01 weight sections -- It is the coal chemical product V-70 made from Wako Pure Chem Industry of an azobis system as a radical polymerization initiator. The 0.06 weight sections, It is Ciba-Geigy tinuvin P as an ultraviolet ray absorbent. It is Shin-etsu silicone KF353 made from Shin-etsu Chemistry A as the 0.05 weight sections and a release agent. The 0.02 weight sections were added and the mixed dissolution was carried out. This mixing liquid was poured into the mold which consists of a gasket of the glass mould of two sheets, and the product made from plastics, this was put into the hot blast circuit system heating furnace, and it heated at 37 degrees C for 8 hours, and temperature up was carried out to 90 degrees C over 8 hours after that, it heated as it is for 2 hours, and the polymerization was performed. The polymer which removed the mold and was obtained was a lens with the high transparency of 2.0mm [in the diameter of 75mm, and thickness], and frequency 0.00 diopter. This was heated at 120 more degrees C for 2 hours, and annealing was performed.

[0040] UV irradiation colored the obtained plastic lens and it had the photochromic nature decolorized by ultraviolet-rays protection from light. Drawing 1 shows the responsibility of the permeability change of this lens at the time of the UV irradiation by the high-pressure mercury-vapor lamp and protection from light by 554nm. the temperature at this time -- 20 degrees C -- it is -- the ultraviolet-rays reinforcement of a lens side -- the product made from USHIO Electrical and electric equipment -- it was 1.2mW when measured by addition actinometer UIT-102 (electric-eye UVD365PD).

[0041] PR-501 made from Yamato Science A was used for the photochromic plastic lens obtained in the [example 2] example 1, and plasma treatment was performed for 1 second to the bottom of a nitrogen 0.6Torr ambient atmosphere. Then, the coating constituent (A)

was applied in the dipping method (a part for 20cm/in raising rate), and heat hardening of this was carried out for 90 minutes at 120 degrees C. In this way, it was obtained, and the assessment result of a lens with the hardening film was excellent in surface hardness, adhesion, and an appearance, as shown in a table 1. Moreover, this lens with the hardening film had photochromic nature equivalent to the lens of an example 1, and the responsibility of the permeability change of this lens at the time of UV irradiation and protection from light by 554nm was equivalent to the example 1. Therefore, it was what can be suitably used as a photochromic lens for glasses.

[0042] Except having changed the class of [examples 3-10] plasma treatment conditions and coating constituent, as shown in a table 1, the lens with the hardening film was produced like the example 2, and it evaluated similarly. The result was excellent in surface hardness, adhesion, and an appearance, as shown in a table 1. Moreover, these lenses with the hardening film had photochromic nature, and were what can be suitably used as a lens for glasses. The responsibility of the permeability change of this lens at the time of UV irradiation and protection from light by 554nm was equivalent to the example 1.

[0043]

[A table 1]

表 1

	プラズマ処理条件			コーティング 組成物 SiO ₂ mol%	表面 硬度	密着性	外観
	気体	気圧	処理時間				
実施例2	窒素	0.6Torr	1秒	(A) 80%	A	100/100	良好
実施例3	窒素	0.8Torr	1秒	(A) 80%	A	100/100	良好
実施例4	窒素	0.6Torr	10秒	(A) 80%	A	100/100	良好
実施例5	窒素	0.6Torr	1秒	(B) 85%	A	100/100	良好
実施例6	酸素	0.6Torr	1秒	(A) 80%	A	100/100	良好
実施例7	酸素	0.6Torr	1秒	(B) 85%	A	100/100	良好
実施例8	アルゴン	0.6Torr	1秒	(A) 80%	A	100/100	良好
実施例9	空気	0.6Torr	1秒	(A) 80%	A	100/100	良好
実施例10	空気	0.6Torr	1秒	(B) 85%	A	100/100	良好

[0044] Except having changed the presentation of [examples 11-18] monomer mixture, as shown in a table 2, after obtaining a plastic lens like an example 1, plasma treatment and coating processing were performed like the example 2, and the lens with the hardening film was obtained. It evaluated similarly about the obtained lens with the hardening film. The result was excellent in surface hardness, adhesion, and an appearance, as shown in a table 2. Moreover, these lenses with the hardening film had photochromic nature, and were what can be suitably used as a lens for glasses. The responsibility of the permeability change of this lens at the time of UV irradiation and protection from light by 554nm was equivalent to the example 1.

[0045] Other than having not used the cross-linking monomer of the (c) component, as shown in the [example 1 of comparison] table 2, although it was going to produce the plastic lens like the example 1, it deformed at the time of annealing and did not become a good lens configuration.

[0046]

[A table 2]

表 2

	基材樹脂組成 (重量%)			表面硬度	密着性	外観
	(a) 成分	(b) 成分	(c) 成分			
実施例 11	MMA 55	HEMA 25	EDMA 20	A	100/100	良好
実施例 12	MMA 70	HEMA 20	EDMA 10	A	100/100	良好
実施例 13	MMA 75	HEMA 20	EDMA 5	A	100/100	良好
実施例 14	MMA 65	HEMA 15	EDMA 20	A	100/100	良好
実施例 15	MMA 45	HEMA 15	4EDMA 40	A	100/100	良好
実施例 16	MMA 65	HEA 15	EDMA 20	A	100/100	良好
実施例 17	MMA 65	HPMA 15	EDMA 20	A	100/100	良好
実施例 18	MMA 65	CHPMA 15	EDMA 20	A	100/100	良好
比較例 1	MMA 85	HEMA 15	EDMA 0	アニール時に変形		

MMA : メタクリル酸メチル

HEMA : メタクリル酸-2-ヒドロキシエチル

EDMA : エチレングリコールジメタクリレート

4EDMA : テトラエチレングリコールジメタクリレート

HEA : アクリル酸-2-ヒドロキシエチル

HPMA : メタクリル酸-2-ヒドロキシプロピル

CHPMA : メタクリル酸-3-クロロ-2-ヒドロキシプロピル

[0047] It is the coal chemical product V-70 made from Wako Pure Chem Industry of an azobis system to the [example 19] methyl-methacrylate 70 weight section as the 5-chloro INDORINOSUPIRO naphth oxazine 1.0 weight section and a radical polymerization initiator as the 2-hydroxypropyl methacrylate 20 weight section, the ethylene glycol

dimethacrylate 10 weight section, and a photochromic color. It is Shin-etsu silicone KF353 made from Shin-etsu Chemistry A as the 0.06 weight sections and a release agent. The 0.03 weight sections were added and the mixed dissolution was carried out. The polymerization was performed like the example 1 using this mixing liquid, the hard facing film was given, and the lens with high transparency was obtained. In this way, the obtained lens was excellent with surface hardness A and adhesion 100/100. Moreover, this lens had photochromic nature and was what can be suitably used as a lens for glasses. Drawing 2 shows the responsibility of the permeability change of this lens at the time of the UV irradiation by the high-pressure mercury-vapor lamp and protection from light by 610nm. the temperature at this time -- 21 degrees C -- it is -- the ultraviolet-rays reinforcement of a lens side -- the product made from USHIO Electrical and electric equipment -- it was 1.2mW when measured by addition actinometer UIT-102 (electric-eye UVD365PD).

[0048] It is the coal chemical product V-70 made from Wako Pure Chem Industry of an azobis system to the [example 20] methyl-methacrylate 40 weight section as the methacrylic-acid-2-hydroxyethyl 14 weight section, the ethylene glycol dimethacrylate 6 weight section, the SUPIRO oxazine system photochromic color content acrylic monomer Sunmax40 weight section (made in Tsukuba Science laboratory), and a radical polymerization initiator. It is Shin-etsu silicone KF353 made from Shin-etsu Chemistry A as the 0.20 weight sections and a release agent. The 0.03 weight sections were added and the mixed dissolution was carried out. The polymerization was performed like the example 1 using this mixing liquid, the hard facing film was given, and the lens with high transparency was obtained. In this way, the obtained lens was excellent with surface hardness A and adhesion 100/100. Moreover, this lens had photochromic nature and was what can be suitably used as a lens for glasses. Drawing 3 shows the responsibility of the permeability change of this lens at the time of the UV irradiation by the high-pressure mercury-vapor lamp and protection from light by 610nm. the temperature at this time -- 24 degrees C -- it is -- the ultraviolet-rays reinforcement of a lens side -- the product made from USHIO Electrical and electric equipment -- it was 1.2mW when measured by addition actinometer UIT-102 (electric-eye UVD365PD).

[0049]

[Effect of the Invention] According to this invention, the acrylic plastic lens which has sufficient photochromic nature can be obtained. Moreover, the good hardening film which was [with a request] extremely excellent in adhesion with the high degree of hardness can be formed in the obtained photochromic plastic lens. The photochromic plastic lens obtained by this invention is very useful as a lens for glasses.

[Translation done.]

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1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

CLAIMS

[Claim(s)]

[Claim 1] The manufacture approach of the photochromic plastic lens characterized by including the process which obtains the plastic lens which has photochromic nature by carrying out the polymerization of the monomer mixture which uses (a), (b), (following c), and the following (d) component as a principal component under the polymerization conditions which do not contain a peroxide system polymerization initiator.

(a) At least one sort of hydrophilic monomers, the photochromic color of at least one sort of polyfunctional cross-linking monomers, and (c) (d) effective dose which are chosen from at least one sort of methacrylic system monomers and the (b) (meta) acrylic acid which are chosen from monofunctional methacrylic ester and polyfunctional methacrylic ester, and hydroxyl-group content (meta) acrylic ester.

[Claim 2] The approach according to claim 1 of including further the process which applies and hardens the coating constituent which carries out plasma treatment of said plastic lens, and subsequently uses following (e) and (f) component as a principal component, and forms the hardening film.

(e) The organic silicon compound, (f) colloid silica which have a silanol group and an epoxy group.

[Claim 3] The approach according to claim 1 or 2 a plastic lens is a spectacle lens.

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